

NISTTech

Compact Atomic Magnetometer and Gyroscope Based on a Diverging Laser Beam

Very small, inexpensive and sensitive magnetometers and gyroscopes

Description

Very small, sensitive atomic magnetometers and gyroscopes are made of a vapor cell holding polarized alkali atoms which react to polarized light from a semiconducting laser or similar source. A photo-detector measures the magnetic field strength caused by the interaction between alkali metal atoms and the polarized light.

The polarized light beam can be attenuated or spatially configured (divergent or convergent). The reaction of the alkali atoms to the magnetic field produced by the polarized light is detected by monitoring the absorption of the edges of the diverging light beam of a probe. Adding a magnetic shield and other minor modifications produces a tiny, sensitive gyroscope.

Applications

- **Senses magnetic fields**
Applications include geophysical surveying, nuclear magnetic resonance (magnetic resonance imaging), magneto-cardiography, magneto-encephalography and perimeter surveillance
- **Rotation-sensing**
These instruments are used in inertial navigation and platform stabilization (anti-roll systems in cars, for example)

Advantages

- **High sensitivity and low cost**
- **Small size and low power consumption**
- **Remote deployment**
Able to operate remotely for an extended time under battery power
- **Handheld, portable applications**

Abstract

An atomic magnetometer that simultaneously achieves high sensitivity, simple fabrication and small size. This design is based on a diverging (or converging) beam of light (in a single spatial optical mode) that passes through an alkali atom vapor cell and that contains a distribution of beam propagation vectors. The existence of more than one propagation direction permits longitudinal optical pumping of the atomic system and simultaneous detection of the transverse atomic polarization. The design could be implemented with a micromachined alkali vapor cell and light from a single semiconductor laser. A small modification to the cell contents and excitation geometry allows for use as a gyroscope.

Inventors

- Kitching, John
- Donley, Elizabeth A.
- Hoodby, Eleanor
- Shkel, Andrei
- Eklund, E. Jesper

Citations

1. E.A. Donely, E. Hoodby, J.E. Eklund, J. Kitching and A. Shkel. Demonstration of high-performance compact magnetic shields for chip-scale atomic devices. Rev. Sci. Instrum. 78, 083102, 2007.

Related Items

- Atomic Devices and Instrumentation Group

References

- U.S. Patent # 7,872,473 issued 2/12/2009, expires 9/25/2028
- Docket: 07-017

Status of Availability

This invention is available for licensing exclusively or non-exclusively in any field of use.

